Nominal Facts and The October 1979 Policy Change

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William T. Gavin and Finn E. Kydland

ABSTRACT

Gavin and Kydland (1999) calculated the cyclical properties of money and prices for the periods before and after the October 1979 policy change. In this article, we extend that work by adding four more years of data and including a study of nominal interest rates and inflation. The adoption of a disinflation policy in October 1979 does not appear to have had a measurable impact on the cyclical properties of real variables. However, it made a dramatic difference in the cyclical properties of nominal variables. We also examine the covariance structure of several nominal relationships: the autocovariance of inflation, the lag from money growth to inflation, and lag from money growth to nominal GDP growth. Generally, the monetary policy in the early period allowed the average inflation rate to ratchet upward with each business cycle. This policy was associated with high variances, high autocorrelations, and high cross-correlations among nominal variables. The moderate inflation policy followed in the second period was associated with lower mean growth rates, less volatility, and lower cross-correlations between money growth and inflation.

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There is a consensus concerning business cycle facts when the facts are about real variables. For example, Backus and Kehoe (1992) note that there is a similarity among covariance structures of real time series taken from different countries and from different sample periods within a country. This consistency across data sets is no doubt one reason for the large amount of research on real business cycles.

This consistency does not extend to data sets that include money and prices. Backus and Kehoe (1992) found that the cyclical properties of money and prices were unstable across historical periods and across countries. Rolnick and Weber (1997) noted that the time-series properties of the prices and money are very different in economies with commodity money standards than are in economies with fiat money standards. Kydland and Prescott (1990) noted disagreement among economists about the cyclical patterns in prices. Wolf (1991), Cooley and Ohanian (1991) and Pakko (2000) show that the cyclical behavior of prices in the United States varies from one episode to the next. Several researchers have attributed this instability to changing policy regimes. For example, Friedman and Kuttner (1992) found that nominal-real relationships deteriorated following the Federal Reserve's policy change in 1979:Q3. Bryan and Gavin (1994) and Gavin and Kydland (1999) show that the correlations involving nominal variables of U.S. data are very different in the period from 1959:Q1 to 1979:Q3 than they are in data sets that begin in 1979:Q4.

While economists looking for the facts have tended to combine data across policy regimes, there are many examples of empirical research where researchers have limited

their data to the post 1979 data in recognition of instability in the data.[1] Many business economists have stopped using the pre-1980 data in the financial sector equations of forecasting models.[2] Naturally, the area where the awareness of the instability caused by the policy shift is most acute is in modeling the monetary policy reaction function. Empirical work in this area has been more careful about the break in the covariance structure associated with policy changes. Empirical studies on policy rules tend to split the sample in 1979 or to use data series beginning sometime after October 1982 when the nonborrowed reserve operating procedure was abandoned. See, for example, work by Coleman, Gilles and Labadie (1993), Taylor (1993), Clarida, Gali, and Gertler (1998), Judd and Rudebusch (1998), Rudebusch and Svensson (1999), McNees (1992), Mehra (1999), Kozecki (1999), Salemi (1995) and many of the studies in Taylor (1999).

Our goal is to document the nominal facts using as little theory as possible. Gavin and Kydland (1999) calculated the cyclical properties of money and prices for the periods before and after the October 1979 policy change. In this article, we extend that work in several ways. We add four more years of data. We examine the cyclical properties of nominal interest rates and inflation. Finally, after looking at the cyclical behavior of nominal variables we examine the covariance structure of several nominal relationships: the autocovariance of inflation, the lag from money growth to inflation, and lag from money growth to nominal GDP growth.

In the first part of the paper where we examine cyclical facts, we transform the data using the Hodrick-Prescott (H-P) filter. We have detrended all the series, including those for

[1] Kydland and Prescott (1990), Cooley and Hansen (1995), Fuhrer and Moore (1995) and Stock and Watson (2000) report statistics on the cyclical properties of nominal variables using data sets that span the October 1979 policy shift.

inflation and interest rates. We construct the trends using the data from the full sample available, even in cases where we think there may be important breaks in the series. We do this partly because we do not know ahead of time whether there really are breaks in the series. Furthermore, even if such breaks exist, the problems in measuring the trend at the endpoints may be worse than the use of data across regimes. Throughout this first section of the paper, when we refer to a time series such as a monetary aggregate, GDP, or a price index, we are talking about the deviation of the logarithm of the variable from the H-P trend. Since there is some question about whether inflation rates and interest rates should be detrended, we also look at the cyclical properties of these series without filtering them.

In the next section of the article that looks at nominal growth rates, we do not use the H-P filter because we believe that, under fiat money standards, the interesting information in nominal data is the trend induced by monetary policy. While the Fed may have accommodated cyclical demands for money and credit, the behavior of inflation shows that the Fed has induced a long cycle in nominal variables that spans several business cycles. Figure 1 shows CPI inflation between the 1959:Q2 and 1998:Q4. There was a long period of rising inflation, from the beginning of our sample until the end of the 1970s. The inflation rate dropped rapidly in the three years beginning in 1979:Q4. Since then, the Fed seems to have followed a policy of maintaining inflation along a moderate and slightly declining trend.

The Monetary Policy Regime Shift in October 1979. We find a different set of empirical regularities for post-1979 than we find for the pre-1979 period. It is useful to make a distinction between changes in the way the monetary policy decisions are made at FOMC meetings and changes in the way FOMC decisions are implemented by the open

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[2] See for example, the forecasting model of Macroeconomic Advisors, Inc, in which the term structure equation and monetary policy reaction function are estimated using only post-1982 data.

market desk at the Federal Reserve Bank of New York. In October 1979, both types of change were made. After October 1979, the FOMC made policy decisions as if they cared more about deviations of inflation from the implied objective than they did before October 1979.[3] The FOMC also changed the procedure the Desk used to implement the decision made at the meeting.

FOMC Decision-making. The FOMC chooses the policy setting at its policy meetings. Perhaps the best way to think about this is as a decision about where to locate the money supply function. The decision, both before and after the October 1979 policy change, was to supply reserves in a way that is expected to lead to desired outcomes for inflation, and output growth. Each decision was also expected to result in particular outcomes for the fed funds rate and the growth in the targeted monetary aggregates, particularly M1. A combination of theory, econometric models, and judgment would go into these decisions. Before 1979, monetary policy resulted in a high and variable outcome for inflation. After October 1979, the FOMC appeared to put relatively more weight on controlling money growth and inflation.[4] Gavin and Kydland (1999) show that shifts of this sort would be expected to lead to significant shifts in the cyclical properties of nominal variables. This is the case whether or not the FOMC changes the way it implements the policy decision (its operating procedure).

The Operating Procedure. At the same time that it announced a new commitment to reducing money growth and inflation, the FOMC announced a change in the way the Open Market Desk of the New York Federal Reserve Bank would implement the decisions made at

[3] See Clarida, Gali, and Gertler (1998), McNees (1992), Salemi (1994), and Chapter 7 in Taylor (1999) for econometric evidence about the Fed's reaction function in the two periods. All find a significant increase in the Fed's relative concern about inflation after October 1979.
[4] See references cited in footnote 3.

FOMC meetings.[5] Prior to 1979, the FOMC decided on a target for the federal funds rate, the market interest rate on overnight lending between banks. The FOMC would direct the manager of the System Open Market Account to buy and sell securities in order to maintain the interest rate near the target level. At each FOMC meeting, the staff of the Board of Governors would present the committee with estimates of how much money growth to expect from the alternative fed funds target choices. During the intermeeting period, surprises in the demand for reserves would be accommodated, so that surprises in money demand showed up as variability in the quantity rather than the price of reserves.

On October 6, 1979, Paul Volcker announced that the procedure would be changed, so that the manager of the open market desk would be required to trade securities to achieve weekly targets for a reserve quantity, rather than the fed funds rate. The policy change led to a dramatic, 10-fold increase in the volatility of the fed funds rate and a high correlation among changes in interest rates across the term structure and across national boundaries. The increased interest rate volatility caught the attention of the markets and the public. It probably helped Fed Chairman Paul Volcker achieve credibility for the disinflation policy. It did not, however, seem to lead to better control over the money stock. As inflation fell to around 4 percent at the end of 1982, the Federal Reserve abandoned the reserve-oriented procedure and returned to an operating procedure that was an indirect form of interest rate targeting.[6] In Alan Greenspan's first term as Fed Chairman (which began in 1987), the FOMC returned to an explicit interest rate targeting procedure.

The change in the operating procedure had a predictable effect on the volatility of interest rates. We think it is important to consider the interest rate correlations without the

[5] See Gavin and Karamouzis (1985) for an elementary description of the alternative operating procedures.

subperiod of reserve targeting because the variation in interest rates associated with the nonborrowed reserve operating procedure overwhelmed variation in interest rates coming from other sources. However, this three-year period also included the longest and largest recession of the post WWII era, so we are reluctant to exclude that period in all of our investigations. We note that none of the major results about the money stock, inflation, or the real economy would be qualitatively different if we had excluded that period from the analysis. In general, we think that the high frequency correlations important for understanding financial markets would be affected by the operating procedure, but they are not the focus of this article. In our judgment, the cyclical effect of changes in monetary policy decision-making process will impact the aggregate price, money and output data at business cycle frequencies in a similar manner even under very different procedures for implementing the decisions. The effect of alternative operating procedures on the variability of interest rates was dramatic. However, the short period and severe recession that occurred during the period of nonborrowed reserve operating procedure makes it difficult to say whether the operating procedure had any effect on the cyclical behavior of interest rates.

We begin by reviewing the business cycle facts for the real variables where we show that the covariance structure is relatively stable across the October 1979 policy change. Next, we examine the changes in the cyclical behavior of the monetary aggregates. Here the results are quite spectacular. There were dramatic changes in behavior of all the monetary aggregates. Then, we look at measures of the price level and inflation. Here the results for inflation are almost as dramatic as for the monetary aggregates, but the results for the price level are not. Next, we find that cyclical behavior of nominal interest rates looks much like

[6] See Thornton (1988) for an empirical analysis of the distinction (and similarities) between the Borrowed-Reserve operating procedure adopted in 1982 and an interest rate procedure.

the behavior of inflation, suggesting that the expected inflation premium dominates the real interest rate as a source of cyclical variation in nominal rates. Finally, we examine the covariance structure among some nominal variables: the persistence of inflation as reflected in its autocovariance structure, the cross-correlations between inflation and money growth, and the cross-correlations between growth rates in nominal GDP and four definitions of the money supply.

CYCLICAL PROPERTIES OF NOMINAL TIME SERIES

In Gavin and Kydland (1999), we found that changes in monetary policy affect the cyclical properties of nominal time series much more than they affect the cyclical properties of real time series. Before looking at the cyclical patterns in nominal variables, we begin by reviewing the cyclical behavior of the real variables. There are two differences from the work present in our earlier paper. First, we use business sector output rather than GDP as the measure of output. Business sector output is the measure of output used by the Bureau of Labor Statistics in reporting on labor productivity. The other difference is that we have extended the data set by adding quarterly data for the years 1995 through 1998.

We decided to use business sector output because it is the measure used in calculating productivity and it corresponds more closely with concept of output that we typically use in macroeconomic theories. Using a different measure of output and adding four years to the sample do not change the results reported in our earlier paper. The cross-covariance structure among the real variables we examine—real business sector output, personal consumption expenditures, expenditures on durables, expenditures on

nondurables and services, domestic fixed investment, hours worked, and productivity—appears to be largely unchanged across the 1979 change in monetary policy.

Figure 2 shows the cyclical patterns of real variables for the two periods. We measure cyclical patterns as correlations with the deviations of output from trend. For both of these periods and despite differences in data and time periods, the correlation coefficients are quite similar to those reported by Gavin and Kydland (1999) and earlier by Kydland and Prescott (1990). Hours worked as well as the components of consumption and investment are highly procyclical. Consumption of nondurables and services is less variable than output, while expenditures on durables and all the components of investment are much more variable than output in percentage terms. There does appear to be a change in the cyclical behavior of productivity; it leads the cycle by two quarters in the earlier sub-sample, but appears coincident in the later period.

The last panel in the bottom right hand corner of Figure 1 shows the standard deviations for each of the variables over the separate periods. In each case, the standard deviation is lower during the period following October 1979.[7] The biggest decline was in the standard deviation of productivity growth which was 1/3 lower during the second period.

Table 1 presents evidence about the statistical significance of the differences in the correlation coefficients across sample periods. We construct a Wald test to compare the null hypothesis that the correlation coefficient in the latter period is equal to the correlation coefficient in the earlier period against the alternative that they are not equal.[8] If the two data series are treated as random samples drawn from a bivariate normal

[7] See McConnell and Quiros (2000) for a discussion of the decline in output volatility after 1984.
[8] See Ostle (1963) pp. 225-227, for a detailed description of the test statistic used.

distribution, then the Wald statistic is distributed as a Chi-square with one degree of freedom. The 10 percent critical value is 2.71. There are 8 of 77 statistics in the panel that are greater than 2.71. That is, for 69 of the 77 statistics compared in Table 1, the evidence suggests that the behavior of real variables in the second half of the full sample is the same as in the first half.

There is some doubt about whether the macroeconomic variables can be assumed to follow a normal distribution—an important assumption for the reliability of the Wald test. To check the reliability of the Wald test we constructed small sample critical values from 1000 repetitions of the following experiment. Using actual data from the earlier period (not deviations from trend), we estimated a bivariate vector autoregression that includes business sector output and one of each of the other variables. In every case, we recovered estimates of autoregressive parameters and the covariance matrix. Then these estimates were used with a random number generator to create 1000 artificial series for each pair. Each series is 160 periods long. These series were then detrended, the sample split at period 83 (corresponding to 1979:Q3 in the U.S. sample) and the cross-correlations calculated for each period. For each artificial series, the Wald test was constructed to determine stability across the two periods. The 1000 test statistics were sorted by size, and the one-hundredth largest is reported in parentheses below the Wald statistic. In every case for the real variables, the 10 percent critical value generated by this Monte Carlo method was larger than the asymptotic value implied by the bivariate normal assumption (2.71). This alternative testing procedure makes it more difficult to reject the null hypothesis, so the conclusions regarding the changes in cyclical behavior have a conservative bias. In Table 1, you can see that the small sample 10% critical

value is always larger than the Wald statistic calculated using actual data. Using this Monte Carlo distribution with the real variables, we cannot reject the null hypothesis that the same process generated the cross-correlations from both periods.

Money

In contrast to the real variables we examined in the previous section, the monetary aggregates behaved very differently during the period after October 1979 than they did before. We included analysis of four alternative measures of the money supply. The narrowest aggregate included was the St. Louis Fed's adjusted monetary base (SL Base) as revised by Anderson and Rasche (1996). The transactions aggregate we included was MZM rather than M1 because it includes the sweep accounts that distort the M1 data after 1994; MZM is defined as M2 minus small denomination time deposits, plus institutional money market mutual funds. This aggregate was proposed by Motley (1988). The label MZM, money with zero maturity, was coined by Poole (1991). Finally, we included M2, which is the Federal Reserve's primary monetary target and the M2 monetary services index (M2MSI) as constructed by Anderson, Jones and Nesmith (1997).

Substantial changes occurred in the variability of the monetary aggregates around trend. The narrow aggregates—SL Base and MZM—are less variable before 1979:Q3 than afterward, while the broad monetary aggregates—M2 and M2MSI—become less variable in the latter period. The bottom panel of Figure 3 shows the standard deviation of the alternative measures of the money stocks for the two sub-samples.

There were also large changes in the cyclical correlations shown in Figure 3. Before 1979, all four of the monetary aggregates were highly procyclical. The procyclical behavior practically disappeared in the second period. The contemporaneous correlation of the monetary base with real GDP falls from 0.47 to 0.11. The contemporaneous correlation of M2 drops dramatically, from 0.64 to 0.02. A similar drop occurred with the new measures, MZM and M2MSI.

Other than the dramatic change in contemporaneous correlations, there are few patterns shared by the cyclical behavior of the aggregates. In the earlier period, the SL Base lagged behind the cycle in output; after 1979, it led the cycle by about a year. MZM and M2 led the cycle in both periods. The cyclical pattern for M2 before 1979 was essentially the same as the correlation pattern for MSIM2. But afterwards, they are quite different. Since then, M2 has led the cycle weakly while MSIM2 has lagged by 2 to 5 quarters.

The most important similarity among the monetary aggregates is that they all appear to be unstable across the policy regime switch in 1979.[9] In Table 2 we see that 32 of the 44 cross-correlations are greater than the theoretical asymptotic critical value, 2.71. Using this test, we can reject the hypothesis that the cyclical patterns were the same for all four definitions of money that we considered. When we compare the Wald statistics calculated from the data with the more conservative critical values from our Monte Carlo distribution (shown in parentheses in the bottom panel), we still find that 24 of the 44 are larger than the 10 percent critical values. Clearly, the cyclical properties are different in the two periods.

[9] Friedman and Kuttner (1992) also have documented the instability in the monetary aggregates across the 1979 policy regime switch.

Prices and Inflation

Figure 4 shows the cyclical patterns for the price level measured by the consumer price index (CPI) and the chain price indexes for personal consumption expenditures (PCE) and GDP. All display a similar pattern and a similar change after October 1979. The contemporaneous correlation in the earlier period was approximately –0.8 and rose by about 0.3 in the second period. The consumer price measures lead—with a negative sign—by two quarters in the earlier period and by 4 quarters in the latter period. The GDP chain price index appears to lead—again with a negative sign—by about one quarter in the earlier period and three quarters in the second period. Table 3 reports the tests for stability of the cross-correlations. We find that price and output correlations across the two periods are significantly different if we use the asymptotic 10 percent critical value (2.71). Using the more conservative tests, however, we cannot reject the hypothesis that the price-output correlations are the same across the policy regime switch. Note that this result changed after we added data for the four years, 1995 through 1998. In Gavin and Kydland (1999), we found that some of the cross-correlations were significantly different for both the CPI and the GDP deflator even when we used the more conservative simulated critical values.

The standard deviations for the price level, shown in the bottom right-hand panel of Figure 4, were slightly lower, on average, during the period following 1979 than they were in the period from 1959:Q1 through 1979:Q3. Note, as depicted in Figure 1, the second period average masks a substantial dampening of the variability of inflation throughout the period. There was a dampening of inflation volatility after 1982 and another, more obvious, decline in the 1990s.

Figure 5 shows the cyclical properties of the different inflation rates when measured as deviations from the H-P trend. King and Watson (1994) noted that there was strong evidence of a Phillips curve relationship between the cyclical components of inflation and unemployment. Here we have used detrended output rather than the deviations of unemployment from trend. As suggested by the King and Watson paper, the contemporaneous correlation between deviations of inflation from the H-P trend and business sector output was positive in both periods for the consumer based measures. The cross-correlation with CPI inflation approximately doubled, rising from 0.22 in the pre-1979 period to 0.49 in the latter period. The correlation between inflation using the GDP chain price index and output rose from –0.01 in the earlier period to 0.34 in the latter period. Although the contemporaneous correlations are larger in the second period, the correlations are smaller at longer leads and lags. The top panel of Table 4 shows the Wald statistics and the simulated 10 percent critical values for testing the hypothesis that the correlations are equal across periods. Here, 25 of the 33 cross-correlations display a significant change when we use the asymptotic critical value. When we use the more conservative small sample critical values, we still find that 22 of 33 are significant.

Figure 6 depicts the cross-correlations between detrended output and (unfiltered) inflation. This third method of comparing output and inflation corresponds to a common specification of these variables, as they typically appear in the aggregate supply function of macroeconomic models used by policymakers and their advisors. Inflation is slightly more variable if we do not remove the trend. There is a decline in variability of all three measures of inflation across the date of the policy regime switch. Whether we use the H-P filter has a large effect on the measure cyclical behavior. In Figure 5, where inflation was filtered, we

reported large negative leads in the early period that became smaller in absolute value in the later period. In Figure 6, where inflation was not filtered, the negative leads are smaller in the first period, especially for the GDP chain-price index. However, in the second period, the negative leads are larger in absolute value if we do not filter the data. The bottom panel of Table 4 shows the results when the data are not filtered. The only lead that has a significant change using the asymptotic critical value is for the GDP chain price index at a lead of five quarters. The lagged correlations are smaller in both periods if we do not filter the data, and they change in approximately the same way as in the case of the filtered data. There is a significant decline in the positive correlations for CPI inflation at leads of 3, 4, and 5 quarters that are significant even when we use the more conservative critical values computed in the Monte Carlo simulations.

Interest Rates

We conclude our discussion of the cyclical behavior of nominal variables with three market interest rates—the fed funds rate, the 3-month Treasury bill rate and the 10-year Treasury bond rate. As noted in the introduction, the method the Federal Reserve uses to implement FOMC policy decisions has an important effect on the time series properties of interest rates at high frequencies, days, weeks, months and, perhaps, quarters. While we investigated the effect of omitting the 1979:Q4 to 1982:Q3 data from all of our calculations, it only mattered in the case of inflation and interest rates. We will examine the post-1982:Q3 data for inflation in more detail in the next section. Here, we report cross-correlations between output and interest rates—both interest rates and output measured as deviations from the H-P trend—for three alternative periods: 1959:Q1 to 1979:Q3, 1979:Q4 to 1998:Q4, and

1982:Q4 to 1998:Q4.[10] Whether one should detrend interest rates or not depends on the question being asked of the data. Here, as was the case with inflation, we present the results both with and without the H-P filtering.

We begin by examining interest rates after removing the trend with the H-P filter. Figure 7 shows how the cyclical patterns changed after 1979. Whether we omit the 3-year period from 1979:Q4 to 1982:Q3 or not, there is a damping of the correlations after 1979. The large negative correlation at leads of 4 and 5 quarters rise from about -0.7 in the period before 1979 for all three interest rates to a range between -0.4 and -0.6 in the period after 1979. The dampening also occurs at leads of 3 to 5 quarters. The large positive correlations at these leads falls from about 0.6 in the period before 1979 for all three interest rates to a range between –0.07 and 0.34 in the period after 1979.

Tests for stability are shown in the top panel of Table 5 for the filtered interest rates. The upper three rows report results when we break the sample in October 1979. We can reject the hypothesis that the correlations are stable across the October 1979 policy switch; 20 of 33 Wald statistics exceed the 10% critical value (2.71) implied by theory for large samples. When we compute the small sample distributions using Monte Carlo methods, however, we find that only in the case of the contemporaneous correlation between the 10-year rate and the business sector output can we reject the hypothesis that the correlations are equal across the policy regimes.

The next three rows in the upper panel of Table 5 report the results when we delete the three years, 1979:Q4 through 1982:Q3, from the second period. There is a dramatic increase in the correlations contemporaneously and at a one-quarter lead (shown in Figure 7).

[10] Deleting the first three years has almost no effect on the measured cyclical pattern of the level variables examined in this study, except interest rates.

The important differences that result from omitting the 3-year interval can be seen in our Wald statistics. If we omit those three years and use the H-P filter on interest rates, then we can easily reject the hypothesis that the cyclical patterns are the same before and after October 1979. If we use the filter, the strongest rejections are of the leading correlations.

Figure 8 shows that if we do not use the H-P filter, these interest rate correlations are about 0.3 to 0.4 smaller in absolute value in the first period and only about 0.1 smaller in the second period than observed in Figure 7. Without the H-P filter, these correlations are about same as with the filter in the earlier period and much lower in the latter period.

If we do not use the H-P filter, the leading correlations appear more similar, but the lagging correlations are significantly different. The bottom panel of Table 5 reports the tests for stability in this case. Using the asymptotic critical value of 2.71, we can reject stability for the leading correlations only in the case of the 10-year bond rate. On the other hand, we can reject stability in the lagging correlations for all three interest rates even when using the more conservative small-sample critical values.

The pattern for interest rates mimics closely the pattern for inflation. In all periods shown, interest rates have negative correlation with output at leads, then turn positive contemporaneously and at lags. The change in policy regime mainly raised the correlation at leads and lowered the correlation at lags. Although not shown here, the changes in the patterns observed when we did not use the H-P filter on inflation are similar to the patterns we see when we do not use the H-P filter on interest rates.

Summary of Facts about the Cyclical Properties of Nominal Times Series

The adoption of a disinflation policy in October 1979 does not appear to have had a measurable impact on the cyclical properties of real variables. However, it made a dramatic difference in the cyclical properties of nominal variables. The cross-correlations between the monetary base and business sector output switched signs after the policy regime changed. Negative leads turned positive and positive lags became negative. For the other monetary aggregates, positive leads became smaller and usually insignificant. Generally, the monetary aggregates appear to be less cyclical after 1979.

Price indexes were generally countercyclical in both periods, but the cross-correlations became smaller in absolute value after 1979 and the lead became longer. The absolute size of negative correlation was largest between the leads 2 to 0 before 1979 and between leads 3 to 4 in the period afterwards. We examined the cyclical properties of inflation both with and without H-P filtering since both specifications are used in empirical studies of the aggregate supply function. Before 1979 there is a strong cyclical pattern, a phase shift from the pattern observed for the price level. There is a relatively large negative correlation at leads and a large positive correlation at lags. After 1979, the pattern flattened for all the price indexes. The changes were highly significant. Without the HP filtering in the earlier period, the negative values at leads were close to zero and positive values at lags became as large as 0.4. After October 1979, the negative leads became somewhat larger, but contemporaneous and lagging correlations were close to zero. The cyclical patterns for market interest rates mirrored the patterns observed in the inflation rates.

NOMINAL GROWTH RATES

In the previous section we examined the business cycle properties of nominal variables, using the H-P filter to define the cyclical component. In this section, we examine the relationship among nominal growth rates where the trends are determined by monetary policy. As we saw in Figure 1 and discussed in the introduction, policymakers allowed the inflation rate to drift upward over the period between 1959 and 1980. They appeared to be focussed more sharply on the real variables rather than on controlling inflation. After 1980, The Federal Reserve appeared to be putting relatively more weight on controlling inflation. We examine the covariance structure of data sets that contain growth rates of eight nominal variables: four measures of the money stock (SL Base, MZM, M2, and MSIM2), three price indexes (CPI, PCE chain price index, and the GDP chain price index), and nominal GDP. We begin by comparing simple descriptive statistics—means, standard deviations and the autocorrelation functions—before and after the October 1979 policy switch. Next, we examine the cross-correlation functions between inflation and different measures of monetary growth. Before concluding, we also report the cross-correlations between nominal GDP and monetary growth.

For almost all our results, it doesn't matter much whether or not we omit the period from October 1979 to October 1982. We add footnotes when there were important differences. We decided to omit those three years in this section because

- they were a time of transition when people were learning about the new policy regime,
- there were many regulatory changes during this period which caused abrupt shifts in the time series for measures of the money stock, and

- the nonborrowed reserve operating procedure affected the data at high frequencies and using a first difference filter emphasizes the time series properties at high frequencies.

In all of the results reported for nominal growth rates we are comparing statistics comparing results from the period 1959:1 to 1979:3 with the period from 1982:4 to 1998:4.

The Time-Series Properties of Money Growth, Inflation, and Nominal GDP Growth

As we saw in Figure 1, the important aspect of the policy regime switch was the successful stabilization of inflation at a moderate rate. The average inflation rates were not that much different—the largest difference was in CPI inflation that averaged 4.2 percent in the first period and 3.2 percent in the second. However, there was a large increase in inflation from the early 1960s to the late 1970s, while the inflation rate was much more stable after 1982. There was slight upward trend in the 1980s that reversed in the 1990s.

Somewhat surprisingly, average growth rates of the narrow measures of money, SL Base and MZM, are actually larger following the successful disinflation policy (See the top panel of Figure 9). For the non-interest bearing components of these narrow aggregates, this surprising result can be attributed partly to the one-time shift in the level demand for money that comes from a lower nominal interest rate. Nominal interest rates generally declined throughout the period from 1982 until 1993. For example, the 3-month Treasury bill rate declined from almost 13 percent in the first half of 1983 to average about 3 percent in 1993. There was also a large demand for currency from abroad in the 1980s as the Soviet Union broke up and some high inflation countries in Latin America began to use more U.S. currency. For the interest-bearing components, the more rapid growth can be attributed to

changes in regulations that allowed banks to pay interest on checkable deposits and to offer easy access on demand for some savings-type deposits. These zero maturity deposits are included in MZM and grew rapidly after 1982. The two broad measures of money, M2 and the MSIM2 were lower in the second period.

The variability of the monetary growth rates is about the same or greater after 1982 than it was before 1979—much greater for MZM and slightly less for MSIM2 (See the bottom panel of figure 9). The variability of inflation and nominal GDP growth was substantially lower in the second period than it was in the first.

As shown in Figure 10, the autocorrelation coefficients for the growth rates of the narrow monetary aggregates and all three measures of inflation decay faster after 1982 than they did before October 1979. The autocorrelation functions for M2 and MSIM2 actually rose in the second period for lags 3 and higher. The largest shifts in autocorrelation functions for measures of the money stock occurred in the cases of SL Base and M2 (see Table 6).

Table 6 shows that the shifts in the cases of the chain-price indexes are generally not statistically significant if we use the Monte Carlo critical values. The most significant declines were in the autocorrelations of CPI inflation. This is the one case where excluding the three interim years—1979:4 to 1982:3—was important. If we include these years, we find a more modest decline in the autocorrelation function except at the longest lags.

The Lag from Money to Prices

It is conventional wisdom among macroeconomists and policymakers that there is a long and variable lag between money and the prices.[11] Work by Irving Fisher during the

[11] See Friedman (1961) for an influential discussion of this issue. Bryan and Gavin (1994) and Gavin and Kydland (1999) explore possibility that the variable lag may be due to instability in the policy function.

early part of this century indicated a much shorter lag than is typically found in more recent studies. He thought the lag would be no longer than three months:

> "It was in August, 1915, that the quantity of money in the United States began its rapid increase. One month later prices began to shoot upward, keeping almost exact pace with the quantity of money. In February, 1916, money suddenly stopped increasing, and two-and-a-half months later prices stopped likewise. Similar striking correspondences have continued to occur with an average lag between the money cause and the price effect of about one-and-three quarters months." Fisher (1918, Page 5)

In a recent study using U.S. data from the period from 1965:Q3 to 1995:Q2, Christiano, Eichenbaum, and Evans (1997) report that, following a contractionary monetary policy shock, "The GDP deflator is flat for roughly a year and a half after which it declines." Page 23. One explanation for the difference in perceptions of the lag is the difference the monetary policy regime. Our premise is that the variable lags reflect variation in policy regimes and inflation expectations.

That there will be differences in measures of the lag before and after 1980 is apparent in the data. The cross-correlations between CPI inflation and monetary growth are shown in Figure 11. As the upper left hand panel shows, quarterly series of monetary base growth and inflation were highly correlated in the period before October 1979. Afterwards, the correlation between the two series is approximately zero for all lags back to 12 quarters. As Table 7 shows, the change in the cross-correlations between the monetary base and inflation are larger and more significant than the changes for any of the other aggregates. The Wald test for equality of the correlation coefficient are larger than the Monte Carlo 10 percent critical values for the contemporaneous and 12 lags of monetary growth. The result is not as strong for the other aggregates, mainly because there was not much correlation between money and prices at short lags for MZM and the M2 measures. At lags of 6 quarters or

more, the early period cross-correlations were relatively large and, using the theoretical asymptotic critical value, the correlations were all significantly smaller after 1982. However, only in the case of M2, can we consistently reject equality across the two periods using the more conservative Monte Carlo critical values.

In the early period, the monetary policy allowed the average inflation rate to ratchet upward with each business cycle. This policy was associated with high variances in nominal growth rates and high cross-correlations between monetary base growth and inflation. When the Federal Reserve adopted a successful policy to stabilize inflation at a moderate rate, the cross-correlations with the monetary base went to zero and the autocorrelations of inflation measures decayed more quickly.

The Lag from Money to Nominal GDP

Many economists supported monetary targeting in the 1970s because of the close relationship between growth rates of the money stock and nominal GDP. The St. Louis Equation developed by Andersen and Jordan (1968) was based on this relationship and was the foundation for many small forecasting models until the early 1980s. The breakdown in the relationship between money and nominal output then led many economists to lose confidence in the reliability of monetary targeting as a strategy for running policy.

In earlier sections, we documented a dramatic shift in the cyclical behavior of the monetary aggregates, and a significant shift in the relationship between money growth and inflation. Therefore, we also expected to see a change in the cross-correlations between nominal GDP growth and monetary growth. As Figure 12 shows, this was the case with the SL Base and MSIM2, but not for MZM or M2. In the earlier period, growth in nominal GDP

was correlated with contemporaneous and lagged SL Base growth back to about 6 quarters. The correlation was highest—nearly 0.5—at the first lag and tapered off to values of 0.2 or lower at longer lags. In the second period, the contemporaneous correlation was 0.1 and rose gradually to peak around 0.3 at lag 7 and then fell to zero at the 10-quarter lag. In the case of MSIM2, the cross-correlations at short lags were lower in the second period. As shown in Table 8, the Wald test rejects equality at the second and third lags.

Summary of Fact about Nominal Growth Rates

Generally, the monetary policy in the early period allowed the average inflation rate to ratchet upward with each business cycle. This policy was associated with high variances, high autocorrelations, and high cross-correlations among nominal variables. The moderate inflation policy followed in the second period was associated with lower mean growth rates, less volatility, and lower cross-correlations.

The cross-correlations between nominal GDP growth and growth in MZM and M2 seem to be approximately the same across the October 1979 regime switch. The biggest differences were in the cross-correlations with the monetary base.

CONCLUSION

There are important implications of this paper for building monetary models. Our results show that researchers should take care when they assume that the covariance structure of data sets is stationary. Our results suggest that is generally not the case for nominal time series spanning October 1979. The strategy of modern macroeconomics is to build general equilibrium models and compare the covariance structure of data implied

by the model to the covariance structure observed in the data. Large deviations signal areas for further research. This research strategy has worked better in real business cycle studies because the covariance structure of real variables seem to be relatively stable across countries and policy regimes. It has not worked so well in monetary business cycles because there is no general agreement about the facts. Our results suggest that one way to find regularities in the data may be to examine and compare episodes with similar monetary policy regimes.

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Table 1
Stability Tests -- Cyclical Properties of Real Variables

Variable X	Chi-square test for equality of correlations across sample periods (Break in 1979 Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_{t}	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
Consumption	2.22	0.82	0.07	0.22	0.74	2.76	1.49	0.34	0.09	1.15	2.41
	(5.1)	(5.09)	(5.51)	(6.85)	(8.92)	(9.07)	(5.5)	(5.06)	(5.27)	(6.17)	(6.81)
Durables	1.72	0.51	0.12	0.00	0.16	4.08	3.07	0.97	0.00	0.63	1.73
	(5.69)	(5.01)	(5.02)	(6.08)	(7.55)	(7.63)	(5.33)	(5.2)	(5.53)	(6.19)	(6.93)
Nondurables and Services	2.31	1.12	0.10	0.33	0.59	0.34	0.25	0.05	0.25	1.17	2.13
	(4.82)	(4.31)	(4.31)	(5.38)	(7.94)	(9.86)	(8.04)	(7.63)	(7.47)	(7.79)	(8.22)
Private Domestic Investment	0.02	0.04	0.04	0.12	0.04	0.64	0.00	1.04	0.45	0.10	0.06
	(5.97)	(5.65)	(5.71)	(6.07)	(6.48)	(7.35)	(4.83)	(3)	(2.9)	(2.99)	(3.8)
Fixed Investment	0.32	0.01	0.01	0.02	0.16	2.95	0.27	0.06	0.01	0.00	0.01
	(6.66)	(6.11)	(6.47)	(7.1)	(8.51)	(11)	(7.76)	(5.7)	(4.7)	(4.81)	(5.22)
Hours Worked	3.13	2.15	1.62	1.52	1.44	0.59	0.97	3.73	2.13	1.01	0.76
	(4.27)	(4.15)	(3.91)	(3.84)	(3.66)	(4.36)	(10.1)	(10.53)	(8.97)	(8.3)	(7.61)
Productivity	0.19	1.80	3.88	6.59	4.11	1.71	0.07	0.00	0.44	1.35	4.03
	(10.2)	(6 10.77)	(10.73)	(8.21)	(5.12)	(3.25)	(3.12)	(3.57)	(4.28)	(4.4)	(4.67)

Note: Simulated 10% critical values are shown in parenthesis. The light shading indicates that the Chi-square test statistic is larger than the asymptotic 10% critical value (2.71).
1959:Q1 to 1998:Q4

Table 2
Stability Tests -- Cyclical Properties of Monetary Aggregates

Variable X	Chi-square test for equality of correlations across sample periods (Break in 1979 Q3) X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
SL Base	11.27	7.21	2.02	0.00	1.72	6.05	13.72	20.84	18.10	18.92	19.22
	(8.31)	(8.36)	(8.47)	(9.13)	(9.32)	(9.4)	(9.43)	(9.71)	(10.09)	(11.29)	(11.65)
MZM	0.03	1.29	8.28	14.90	15.35	15.22	12.71	7.81	2.75	0.82	0.30
	(12.68)	(11.66)	(11.68)	(13.43)	(12.84)	(10.33)	(8.4)	(8.18)	(8.66)	(10.01)	(10.52)
M2	2.31	9.87	24.29	34.62	31.14	20.57	10.82	2.54	0.07	2.46	9.82
	(8.41)	(9.18)	(10.01)	(10.8)	(9.85)	(8)	(7.32)	(7.27)	(8.62)	(9.53)	(10.31)
MSIM2	8.54	20.71	40.72	54.09	40.89	19.80	5.44	0.01	6.84	19.44	32.99
	(9.63)	(9.23)	(10.05)	(11.56)	(10.09)	(8.05)	(7.06)	(7.33)	(8.07)	(9.7)	(10.94)

Note: The light shading indicates that the Chi-square test statistic is larger than the asymptotic 10% critical value (2.71). The dark shading indicates that the Chi-square test statistic is larger than the simulated 10% critical value shown in parentheses.
1959:Q1 to 1998:Q4

Table 3
Stability Tests -- Cyclical Properties of the Price Level

Variable X	Chi-square test for equality of correlations across sample periods (Break in 1979 Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_{t}	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
CPI	3.27	0.27	1.87	6.96	9.84	10.74	6.94	2.78	0.29	0.3	3.11
	(8.03)	(10.07)	(13.63)	(16.29)	(15.51)	(12.35)	(7.41)	(6.13)	(5.71)	(6.29)	(7.34)
PCE Chain Price Index	5.11	0.63	1.39	8.45	11.81	10.31	5.09	1.04	0.05	1.75	5.98
	(7.43)	(8.61)	(11.44)	(19.19)	(24.06)	(22.47)	(12.64)	(8.76)	(6.53)	(6.47)	(7.5)
GDP Chain Price Index	8.88	5.53	0.75	0.96	4.62	8.65	6.07	1.91	0.31	0.02	1.45
	(9.28)	(9.25)	(10.33)	(12.36)	(15.82)	(19.78)	(14.09)	(9.94)	(7.82)	(7.27)	(6.91)

Note: Simulated 10% critical values are shown in parenthesis. The light shading indicates that the Chi-square test statistic is larger than the asymptotic 10% critical value (2.71).
1959:Q1 to 1998:Q4

Table 4
Stability Tests -- Cyclical Properties of Inflation

(with H-P filtered inflation)

Variable X	Chi-square test for equality of correlations across sample periods (Break in 1979 Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
CPI inflation (HP)	16.86	17.98	15.4	6.44	3.71	3.54	0.03	3.21	10.38	14.71	15.21
	(6.69)	(5.07)	(4.29)	(3.16)	(2.62)	(2.83)	(3.73)	(5.83)	(6.95)	(7.51)	(7.19)
PCE inflation (HP)	12.04	17.50	16.43	8.60	2.81	1.58	0.18	3.93	9.64	13.20	10.46
	(6.33)	(5.63)	(4.71)	(3.58)	(2.91)	(2.85)	(3.48)	(4.72)	(6)	(5.63)	(5.59)
GDP inflation (HP)	0.32	6.14	13.19	11.21	5.08	4.93	0.70	0.63	0.88	1.86	6.46
	(5.53)	(4.82)	(4.14)	(3.64)	(3.28)	(2.52)	(2.53)	(2.72)	(3.54)	(5.13)	(5.75)

(Infation not H-P filtered)

Variable X	Chi-square test for equality of correlations across sample periods (Break in 1979 Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
CPI inflation	0	0.06	0.18	0.03	0.12	0.04	1.1	2.89	4.64	5.28	5.19
	(5.98)	(7.33)	(6.34)	(6.40)	(5.17)	(4.24)	(4.68)	(4.73)	(4.57)	(4.41)	(4.19)
PCE inflation	0.19	0	0.04	0.03	0.41	0.48	1.66	3.39	4.25	3.56	2.66
	(6.17)	(9.30)	(11.06)	(12.31)	(11.82)	(6.76)	(6.22)	(5.14)	(4.36)	(4.37)	(4.17)
GDP inflation	3.03	0.77	0.05	0.05	0.34	0.21	0.88	2.32	2.01	1.8	2.76
	(5.25)	(8.78)	(10.86)	(12.69)	(12.32)	(8.52)	(7.53)	(6.62)	(4.59)	(4.31)	(4.49)

Note: The light shading indicates that the Chi-square test statistic is larger than the asymptotic 10% critical value (2.71). The dark shading indicates that the Chi-square test statistic is larger than the simulated 10% critical value shown in parentheses.
1959:Q1 to 1998:Q4

Table 5
StabilityTests -- Cyclical Properties of Nominal Interest Rates.

Interest Rates H-P Filtered

Variable X	Chi-square test for equality of correlations across sample periods (Break in 1979 Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
FFED (HP)	3.63	4.44	2.69	1.26	1.69	1.32	0.10	3.72	6.53	4.36	4.18
	(10.08)	(6.65)	(3.97)	(2.5)	(2.18)	(2.61)	(3.8)	(6.96)	(12)	(11.29)	(9.73)
FTB3 (HP)	7.14	7.31	3.15	1.21	2.07	2.39	0.00	2.71	4.15	3.97	5.89
	(8.11)	(5.37)	(3.54)	(2.66)	(2.67)	(3.14)	(4.47)	(7.75)	(9.84)	(9.48)	(7.74)
FCM10 (HP)	5.01	7.00	4.91	4.70	6.51	10.47	6.98	1.91	0.26	0.74	6.32
	(10.61)	(10.1)	(9.94)	(8.84)	(8.34)	(7.79)	(7.41)	(7.1)	(7.77)	(8.35)	(8.99)
	Chi-square test for equality of correlations across sample periods (Omitting 79:Q4 to 82:Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
FFED (HP)	2.05	4.70	5.50	4.37	3.81	5.00	1.94	0.05	2.40	5.27	5.35
	(10.08)	(6.65)	(3.97)	(2.5)	(2.18)	(2.61)	(3.8)	(6.96)	(12)	(11.29)	(9.73)
FTB3 (HP)	5.33	7.11	6.11	4.41	4.78	5.74	1.89	0.18	2.74	5.88	7.05
	(8.11)	(5.37)	(3.54)	(2.66)	(2.67)	(3.14)	(4.47)	(7.75)	(9.84)	(9.48)	(7.74)
FCM10 (HP)	3.94	6.08	6.90	8.96	10.45	13.82	11.46	3.15	0.04	3.81	10.80
	(10.61)	(10.1)	(9.94)	(8.84)	(8.34)	(7.79)	(7.41)	(7.1)	(7.77)	(8.35)	(8.99)

Interest Rates not H-P Filtered

Variable X	Chi-square test for equality of correlations across sample periods (Break in 1979 Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
FFED	0.18	0.12	0.49	1.31	1.72	3.37	7.76	12.10	13.04	11.07	9.20
	(9.22)	(9.45)	(8.74)	(7.16)	(5.46)	(6.42)	(7.70)	(7.92)	(6.85)	(6.74)	(7.24)
FTB3	0.61	0.47	1.35	2.60	2.48	3.29	6.86	10.33	10.72	9.86	9.47
	(5.86)	(4.84)	(5.36)	(5.59)	(5.01)	(5.66)	(6.25)	(6.08)	(5.40)	(5.17)	(5.16)
FCM10	4.27	3.84	4.12	3.77	2.45	1.52	1.91	3.14	4.23	6.00	8.45
	(47.25)	(28.81)	(12.32)	(3.95)	(2.70)	(8.91)	(16.70)	(22.95)	(23.45)	(19.01)	(11.09)
	Chi-square test for equality of correlations across sample periods (Omitting 79:Q4 to 82:Q3)										
	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}
FFED	0.20	0.04	0.11	0.48	1.08	1.91	4.44	8.06	10.59	11.76	11.38
	(9.22)	(9.45)	(8.74)	(7.16)	(5.46)	(6.42)	(7.70)	(7.92)	(6.85)	(6.74)	(7.24)
FTB3	0.50	0.29	0.54	1.15	1.43	1.92	4.08	7.73	9.83	11.30	11.80
	(5.86)	(4.84)	(5.36)	(5.59)	(5.01)	(5.66)	(6.25)	(6.08)	(5.40)	(5.17)	(5.16)
FCM10	2.61	2.37	2.07	1.56	1.05	0.73	0.93	2.59	5.49	8.87	12.00
	(47.25)	(28.81)	(12.32)	(3.95)	(2.70)	(8.91)	(16.70)	(22.95)	(23.45)	(19.01)	(11.09)

Note: The light shading indicates that the Chi-square test statistic is larger than the asymptotic 10% critical value (2.71). The dark shading indicates that the Chi-square test statistic is larger than the simulated 10% critical value shown in parentheses.
1959:Q1 to 1998:Q4

Table 6
Stability Tests -- Autocorrelation Function of Nominal Growth Rates

Variable X	Wald test for equality of auto-correlations across sample periods (1959 Q1- 1979 Q3, 1982 Q4-1998 Q4)											
	X_{-1}	X_{-2}	X_{-3}	X_{-4}	X_{-5}	X_{-6}	X_{-7}	X_{-8}	X_{-9}	X_{-10}	X_{-11}	X_{-12}
SL Base	0.02	0.79	2.13	3.19	6.08	7.08	13.98	10.35	7.57	9.47	12.46	9.52
	(7.65)	(7.16)	(6.45)	(5.17)	(5.37)	(5.68)	(5.74)	(6.19)	(6.18)	(5.60)	(6.14)	(6.21)
MZM	4.31	4.83	2.95	0.14	0.04	0.01	0.96	0.88	1.74	3.39	0.01	0.19
	(4.12)	(4.73)	(5.59)	(6.25)	(5.89)	(6.24)	(5.67)	(5.94)	(5.86)	(6.15)	(5.98)	(5.94)
M2	1.66	0.05	1.12	4.91	9.68	9.86	19.98	19.8	15.24	14.77	6.31	4.52
	(6.46)	(8.55)	(9.48)	(9.75)	(7.52)	(7.09)	(6.79)	(6.82)	(6.33)	(6.23)	(5.85)	(6.07)
MSI M2	0.34	1.52	2.18	2.7	4.39	8.33	10.58	11.09	8.58	3.9	1.86	0.73
	(9.99)	(11.42)	(13.00)	(14.39)	(13.05)	(11.42)	(11.52)	(10.52)	(10.24)	(11.35)	(10.33)	(10.10)
PCE Chain Price Index	13.45	10.28	5.03	5.69	3.74	0.05	0.05	0.75	0.71	2.03	4.03	3.29
	(11.22)	(11.43)	(9.98)	(12.86)	(10.39)	(9.88)	(11.12)	(10.18)	(9.95)	(9.84)	(9.05)	(8.44)
GDP Chain Price Index	6.29	4.45	0.82	1.51	2.48	1.36	0.44	0.83	1.62	1.44	1.44	1.78
	(13.51)	(16.63)	(12.24)	(11.34)	(15.14)	(13.29)	(12.28)	(12.62)	(12.22)	(11.95)	(11.49)	(11.45)
GDP	2.49	0.43	0.26	0.18	1.02	2.44	0.81	3.57	0	0.2	0.19	0.14
	(6.67)	(3.69)	(4.57)	(2.84)	(2.80)	(2.69)	(2.63)	(2.61)	(3.07)	(2.80)	(2.69)	(2.99)
CPI	27.01	32.59	20.51	21.94	17.49	8.81	6.22	8.37	6.88	4.38	8.83	6.9
	(4.73)	(5.14)	(4.90)	(5.45)	(4.40)	(4.52)	(4.95)	(4.31)	(4.29)	(4.32)	(4.10)	(4.04)

Note: The two periods compared are 1959:2 to 1979:3 and 1982:4 to 1998:4. The dark shading indicates that the wald statistic exceeds the small sample 10 percent critical levels that are shown in parantheses. The light shading indicates that the wald statistic exceeds the asymptotic 10 percent critical value (2.71), but not the small sample value.

Table 7
Stability Tests -- Inflation and Monetary Growth

	Chi-square test for equality of correlations across sample periods												
Variable	X_{0}	X_{-1}	X_{-2}	X_{-3}	X_{-4}	X_{-5}	X_{-6}	X_{-7}	X_{-8}	X_{-9}	X_{-10}	X_{-11}	X_{-12}
SL Base	12.63	10.25	12.60	16.97	19.37	18.01	14.19	8.72	8.49	11.57	12.20	8.48	16.26
	(7.11)	(6.36)	(6.74)	(6.47)	(6.74)	(6.46)	(6.33)	(6.22)	(6.40)	(6.19)	(6.37)	(5.95)	(6.58)
MZM	1.36	0.81	1.82	0.62	0.23	1.37	3.13	2.30	1.48	3.92	4.10	1.03	4.43
	(4.04)	(4.69)	(4.51)	(4.47)	(5.19)	(4.84)	(4.33)	(4.40)	(4.07)	(4.20)	(4.79)	(4.29)	(4.36)
M2	2.64	0.00	0.20	0.01	0.00	2.78	6.75	6.87	6.84	8.78	8.45	5.32	8.70
	(7.16)	(6.71)	(6.96)	(7.06)	(7.32)	(6.45)	(5.77)	(6.27)	(6.44)	(6.13)	(6.09)	(6.34)	(6.69)
M2MSI	1.35	0.38	0.07	0.99	1.04	3.13	6.35	7.24	8.00	10.79	8.34	4.94	5.29
	(9.56)	(9.76)	(8.87)	(8.97)	(10.15)	(9.83)	(9.47)	(10.30)	(9.97)	(9.35)	(9.59)	(9.48)	(9.72)

Note: The two periods compared are 1959:2 to 1979:3 and 1982:4 to 1998:4. The dark shading indicates that the wald statistic exceeds the small sample 10 percent critical levels that are shown in parantheses. The light shading indicates that the wald statistic exceeds the asymptotic 10 percen critical value (2.71), but not the small sample value.

Table 8
Stability Tests -- Nominal GDP growth and Monetary Growth

Variable X	Wald test for equality of correlations across sample periods (1959 Q1- 1979 Q3, 1982 Q4-1998 Q4)												
	X_0	X_{-1}	X_{-2}	X_{-3}	X_{-4}	X_{-5}	X_{-6}	X_{-7}	X_{-8}	X_{-9}	X_{-10}	X_{-11}	X_{-12}
SL Base	4.62	6.15	4.32	2.27	0.38	2.27	0.84	0.07	0.69	2.79	4.41	1.69	6.81
	(2.77)	(3.11)	(3.89)	(3.66)	(3.78)	(3.53)	(3.75)	(4.02)	(4.09)	(3.67)	(3.89)	(3.70)	(3.68)
MZM	0.72	0.02	0.50	0.22	1.11	0.01	0.01	0.36	0.33	0.03	1.31	0.52	0.67
	(2.63)	(2.63)	(2.83)	(3.28)	(2.96)	(3.16)	(3.54)	(3.25)	(3.43)	(3.29)	(3.44)	(3.26)	(3.30)
M2	0.11	0.01	0.59	0.00	0.62	0.01	0.04	0.52	1.22	0.83	2.43	1.81	0.03
	(2.17)	(2.13)	(2.36)	(2.22)	(2.11)	(2.17)	(2.33)	(2.19)	(2.22)	(2.34)	(2.44)	(2.27)	(2.23)
M2MSI	0.48	1.86	4.57	2.68	0.24	0.12	0.03	0.08	0.01	0.14	0.02	0.01	0.32
	(2.08)	(2.41)	(2.51)	(2.30)	(2.14)	(2.36)	(2.51)	(2.67)	(2.46)	(2.47)	(2.47)	(2.29)	(2.88)

Note: The two periods compared are 1959:2 to 1979:3 and 1982:4 to 1998:4. The dark shading indicates that the wald statistic exceeds the small sample 10 percent critical levels that are shown in parantheses. The light shading indicates that the wald statistic exceeds the asymptotic 10 percent critical value (2.71), but not the small sample value.

Figure 1
CPI Inflation and H-P Trend

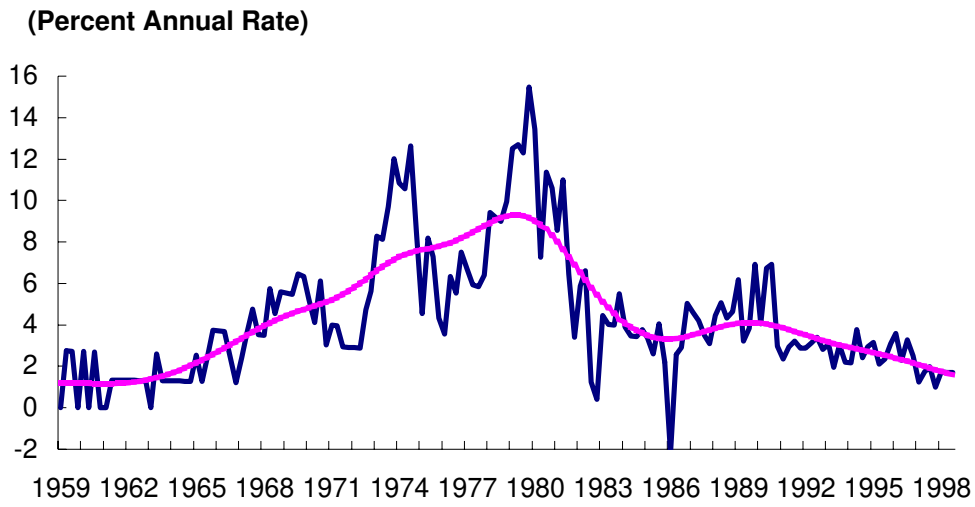


Figure 2
Cyclical Properties of Real Variables

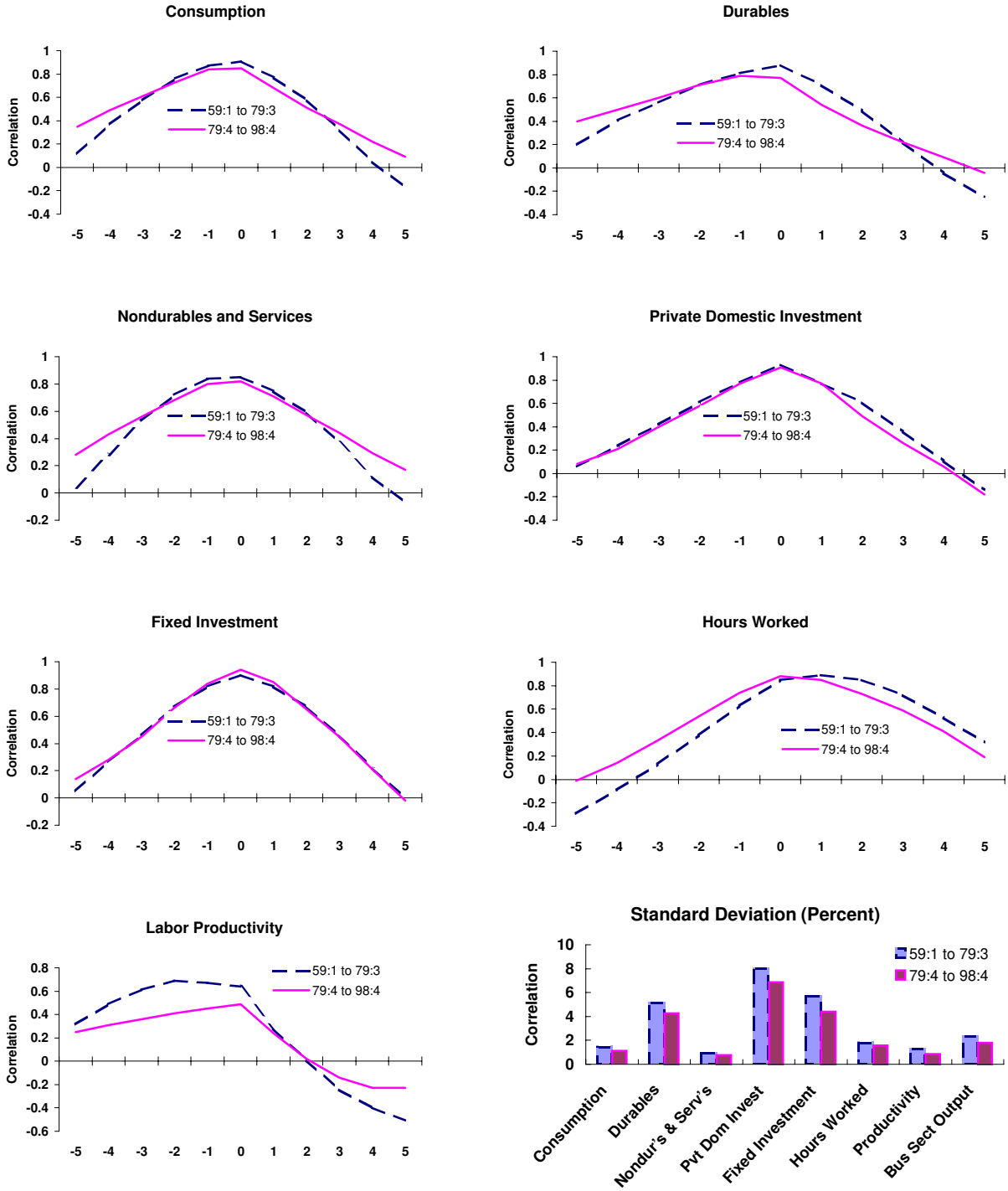
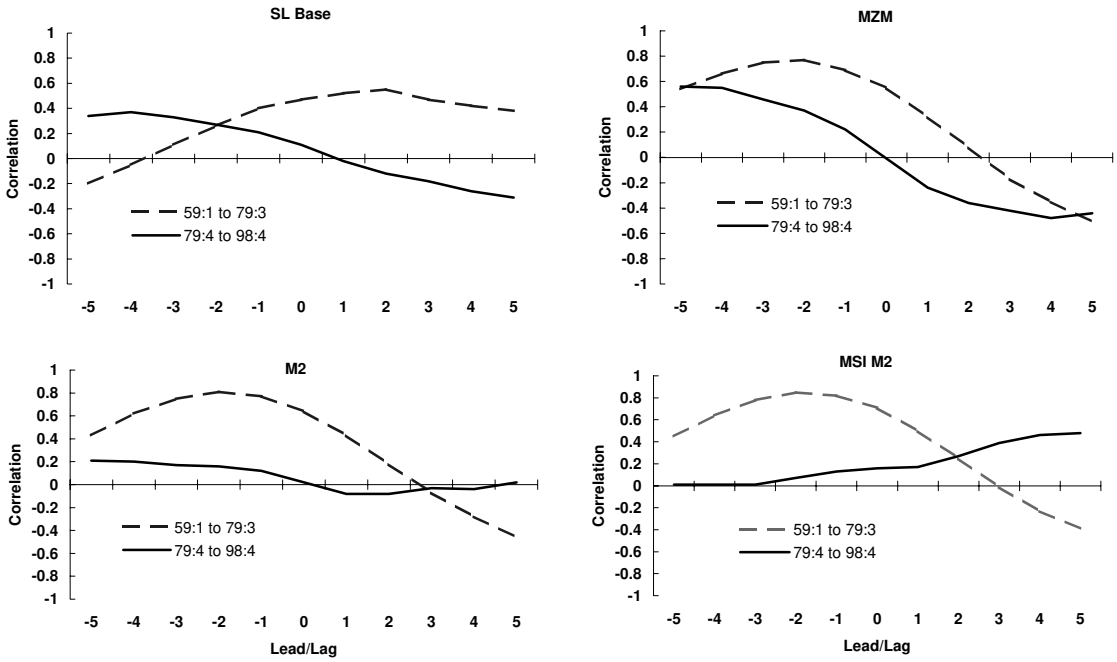


Figure 3
Cyclical Behavior of the Monetary Aggregates



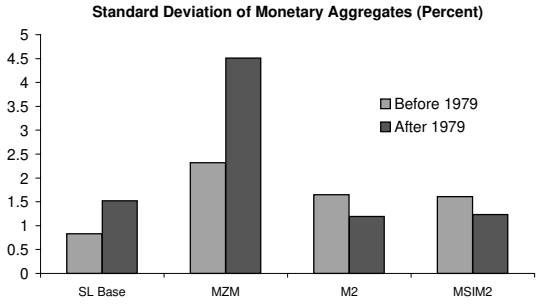
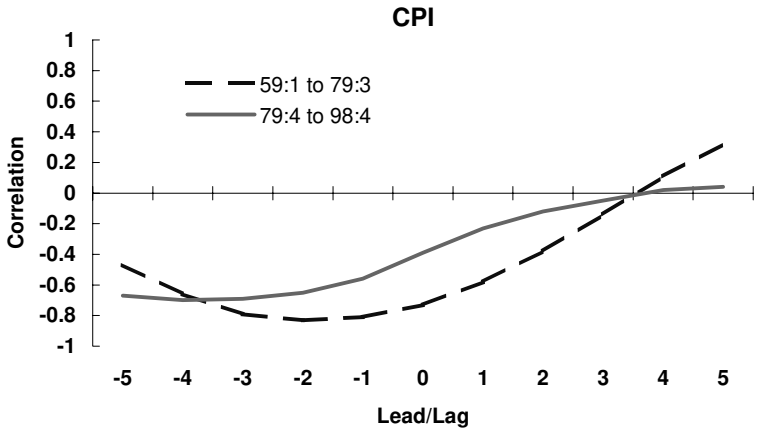
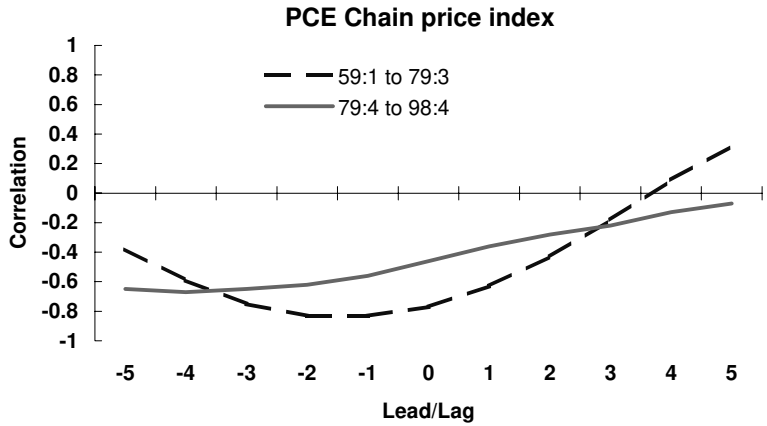
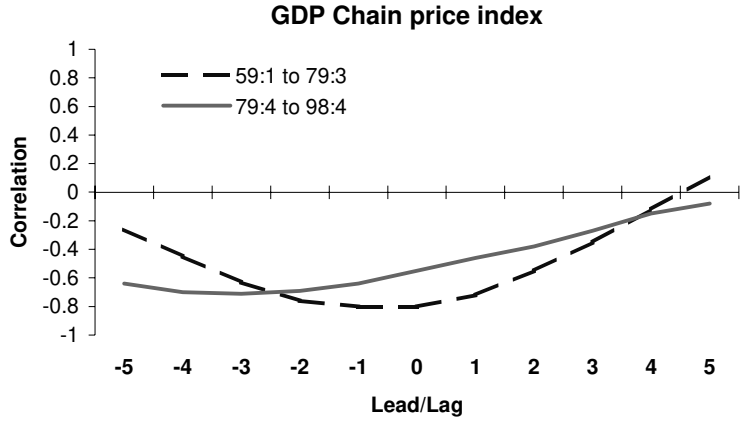


Figure 4
Cyclical Properties of the Price Level







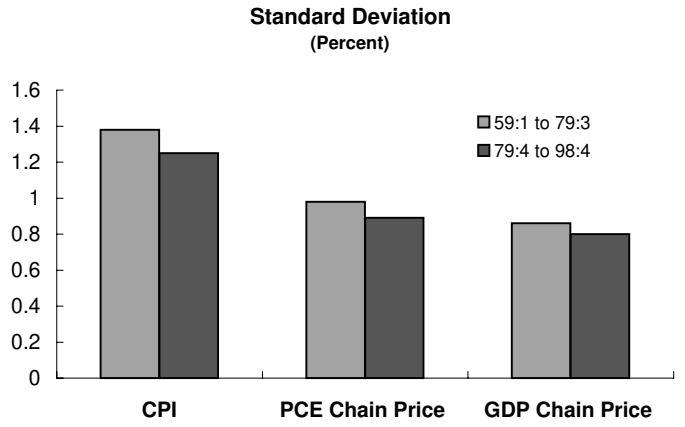
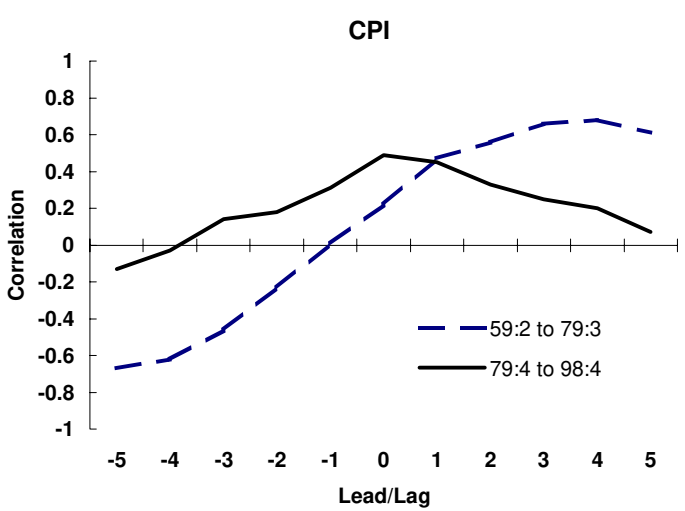
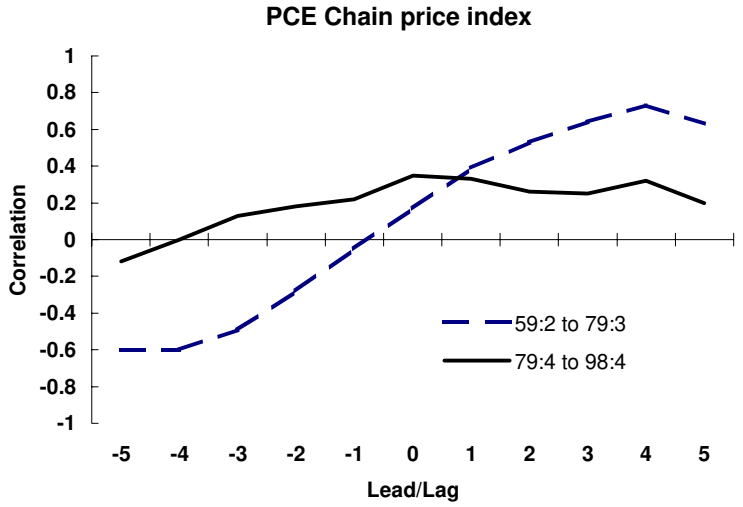
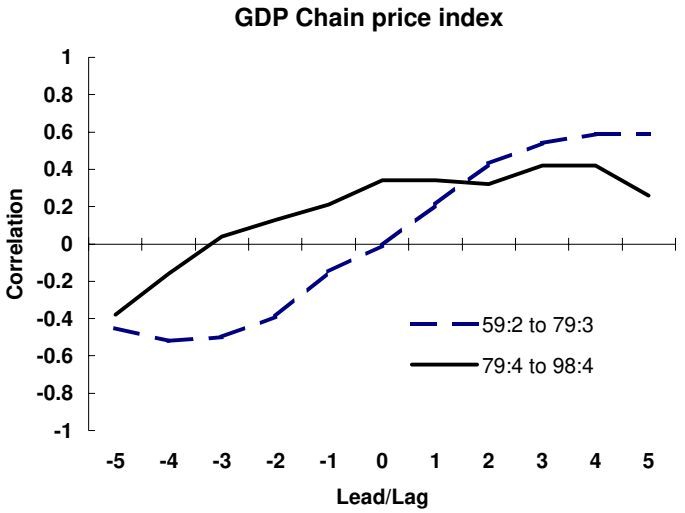


Figure 5: Cyclical Properties of Inflation (H-P Filter)







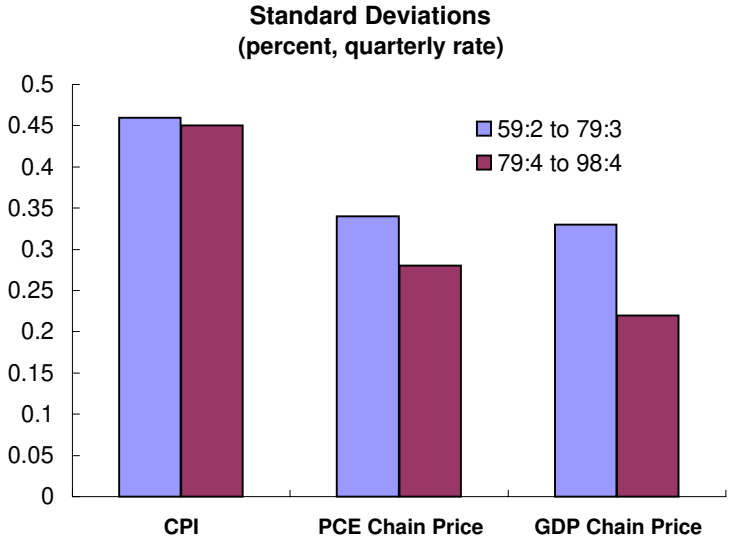
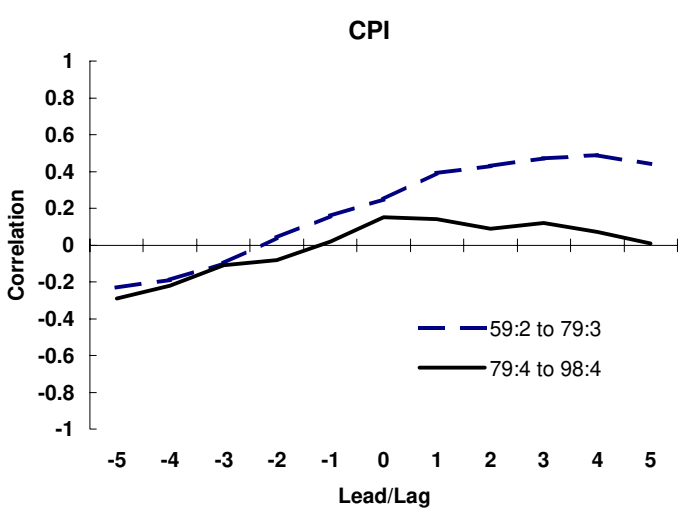
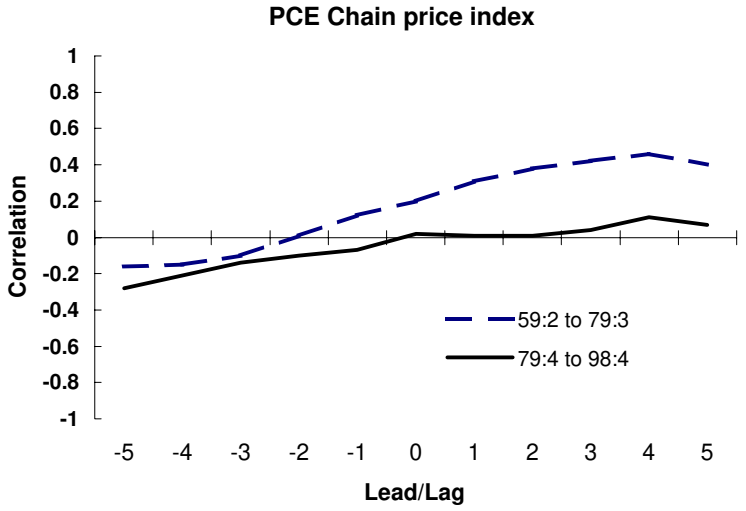
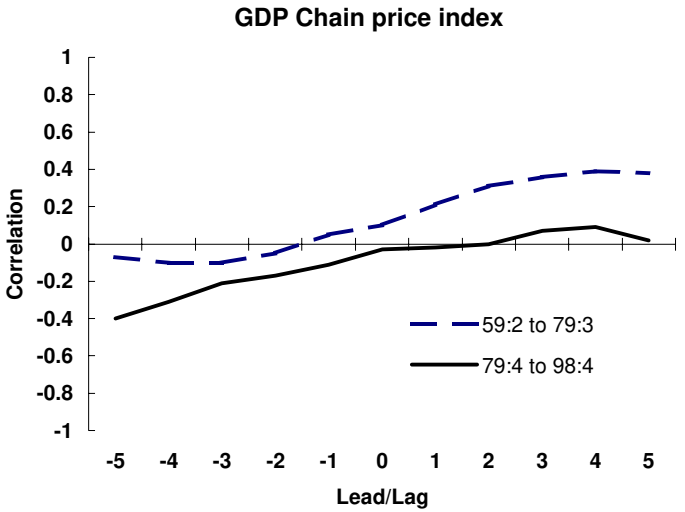


Figure 6: Cyclical Properties of Inflation (no H-P Filter)







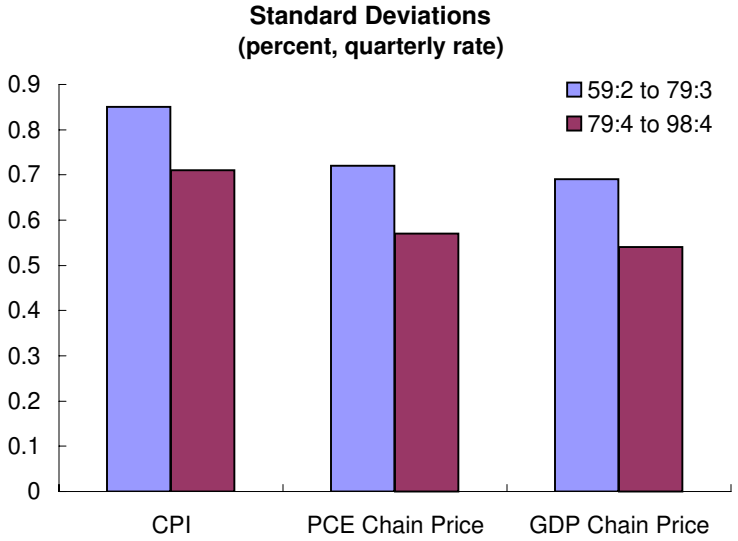
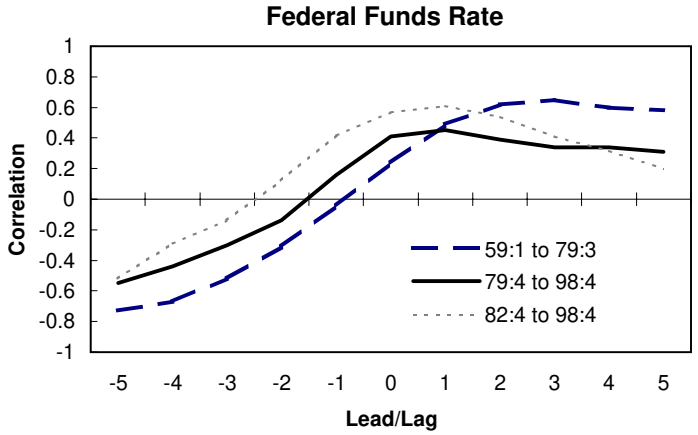
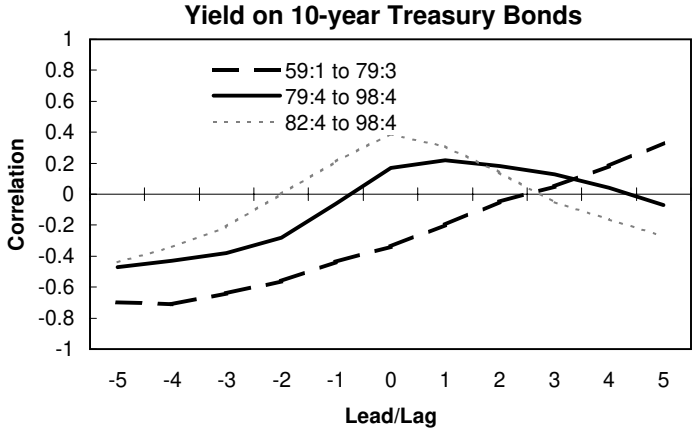
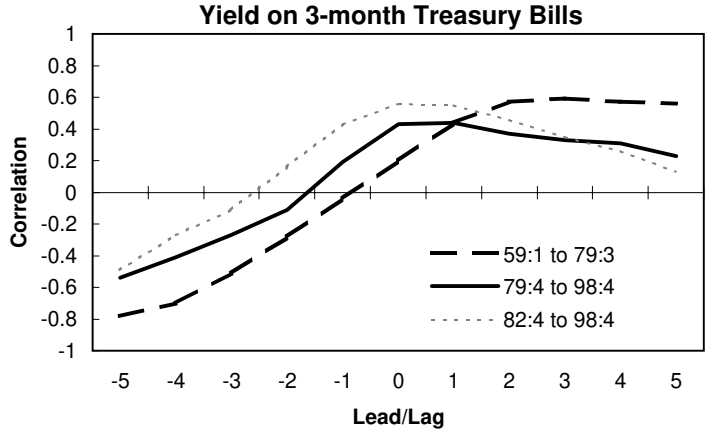


Figure 7: Cyclical Properties of Nominal Interest Rates (H-P filter)







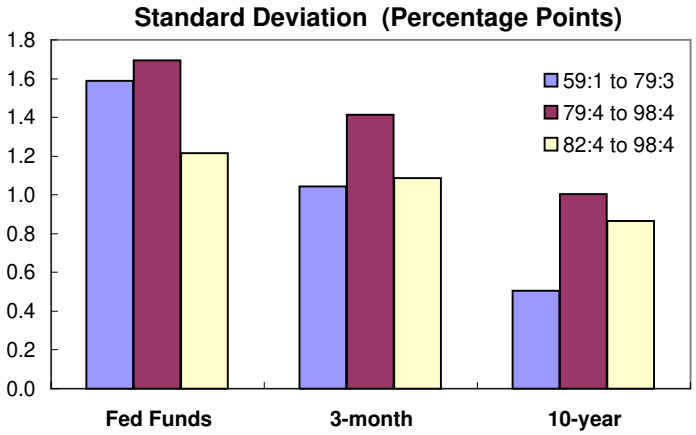
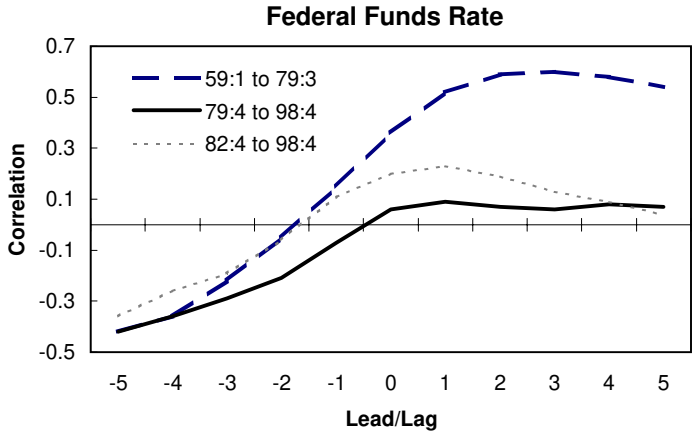
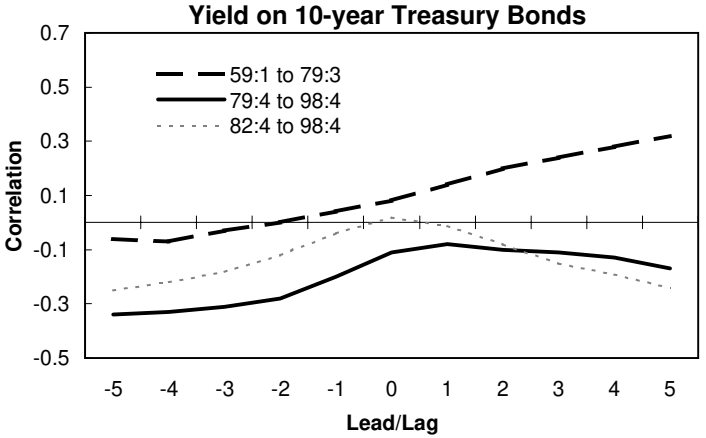
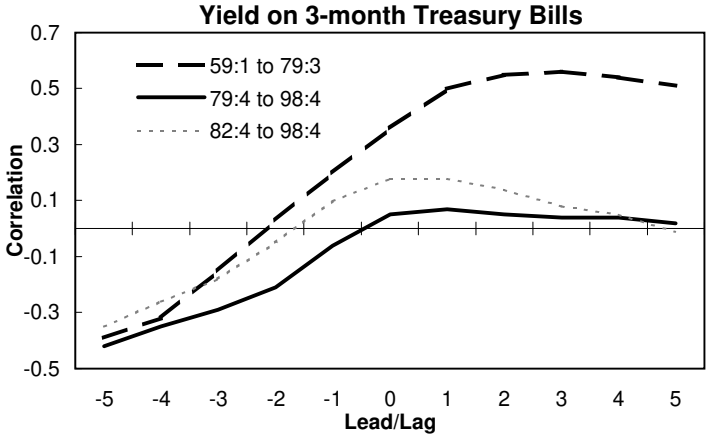


Figure 8: Cyclical Properties of Nominal Interest Rates (no H-P Filter)







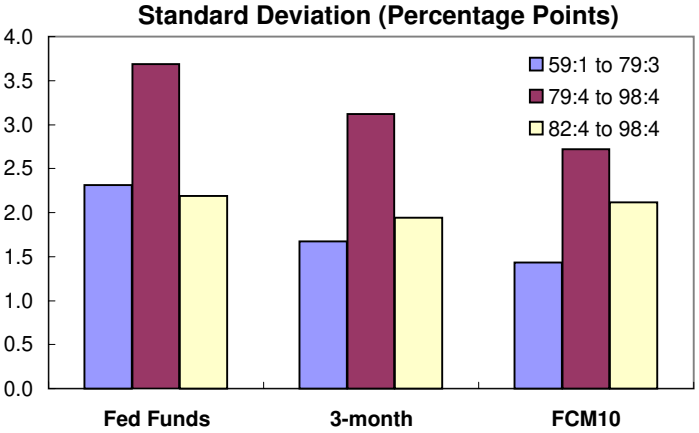


Figure 9

Statistics for Nominal Variables

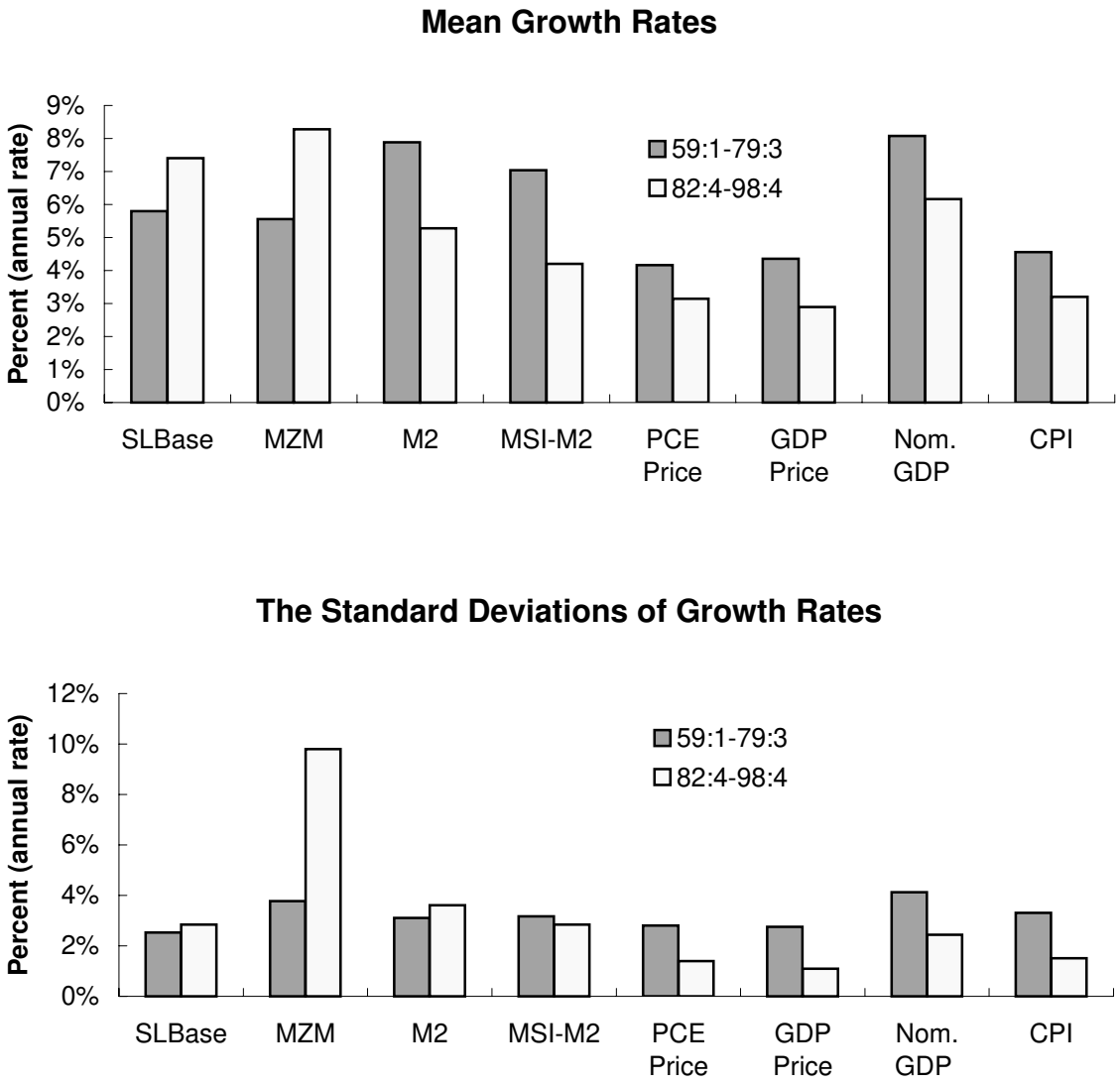


Figure 10
Autocovariance Functions for Nominal Variables

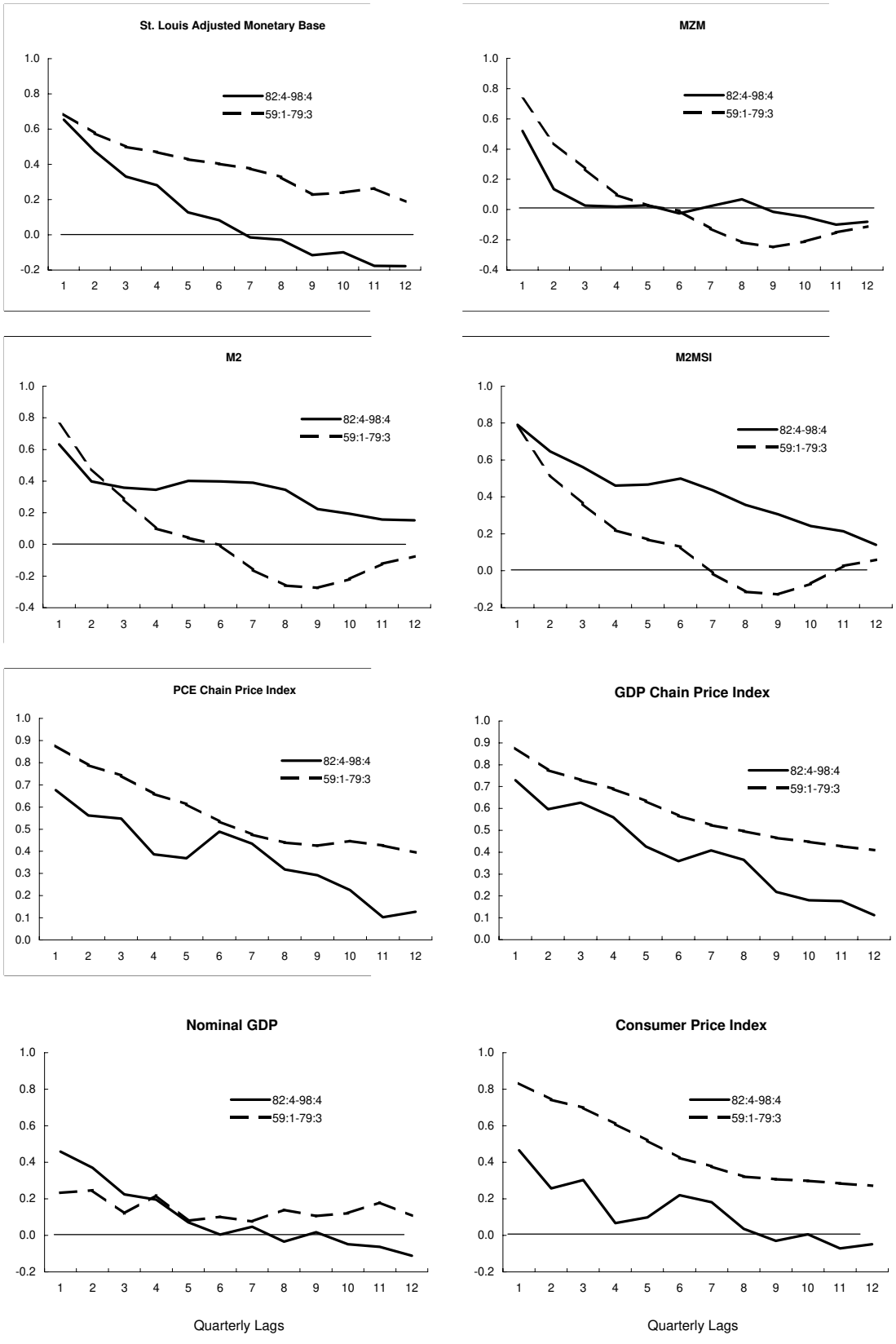


Figure 11
Cross-Correlations between CPI inflation and Monetary Growth

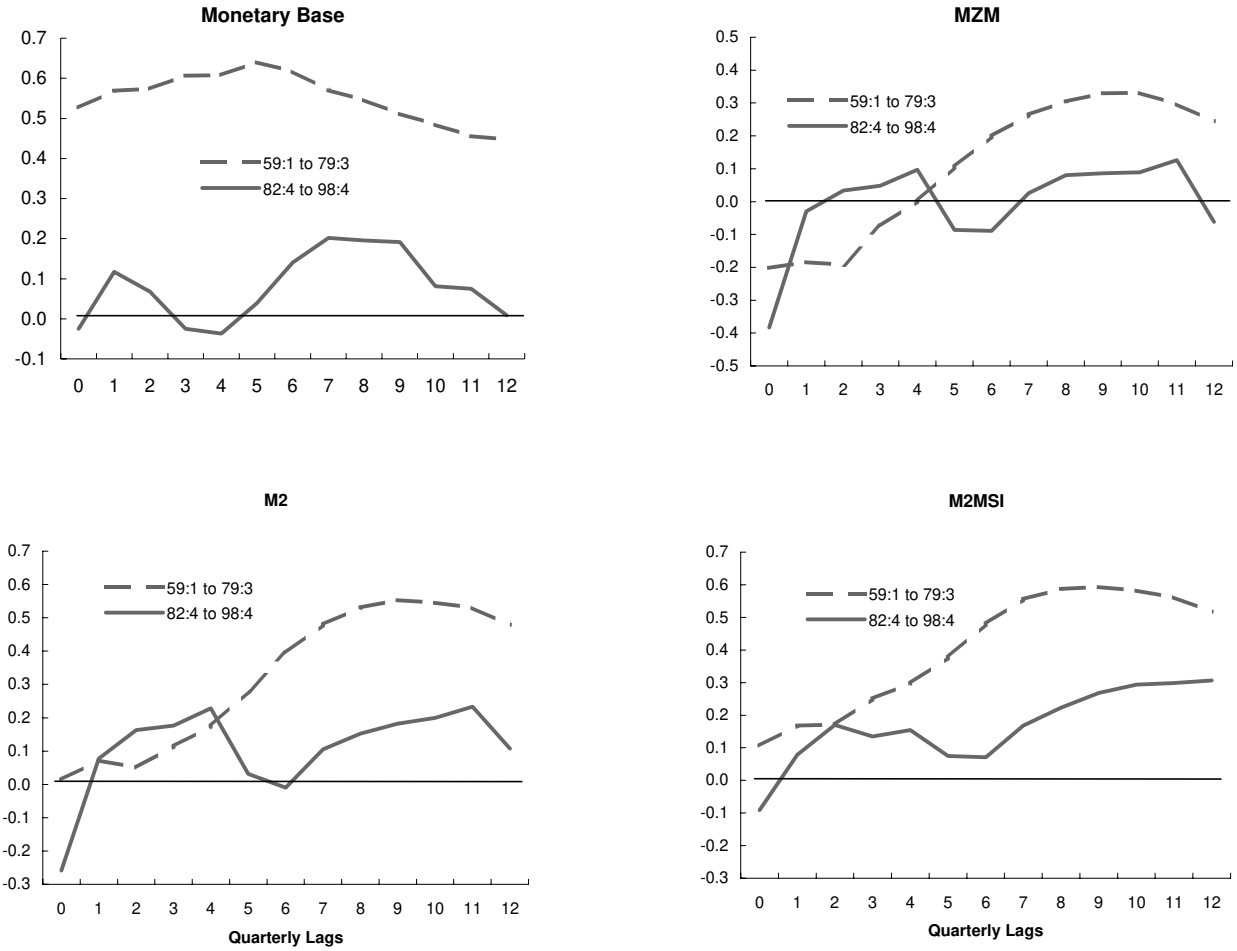


Figure 12
Cross-Correlations between Nominal GDP Growth and Monetary Growth